LoadRunner® 6

The Enterprise Load Testing Tool

End-to-End Load Tests

Single Point of Control

Pinpoint Bottlenecks
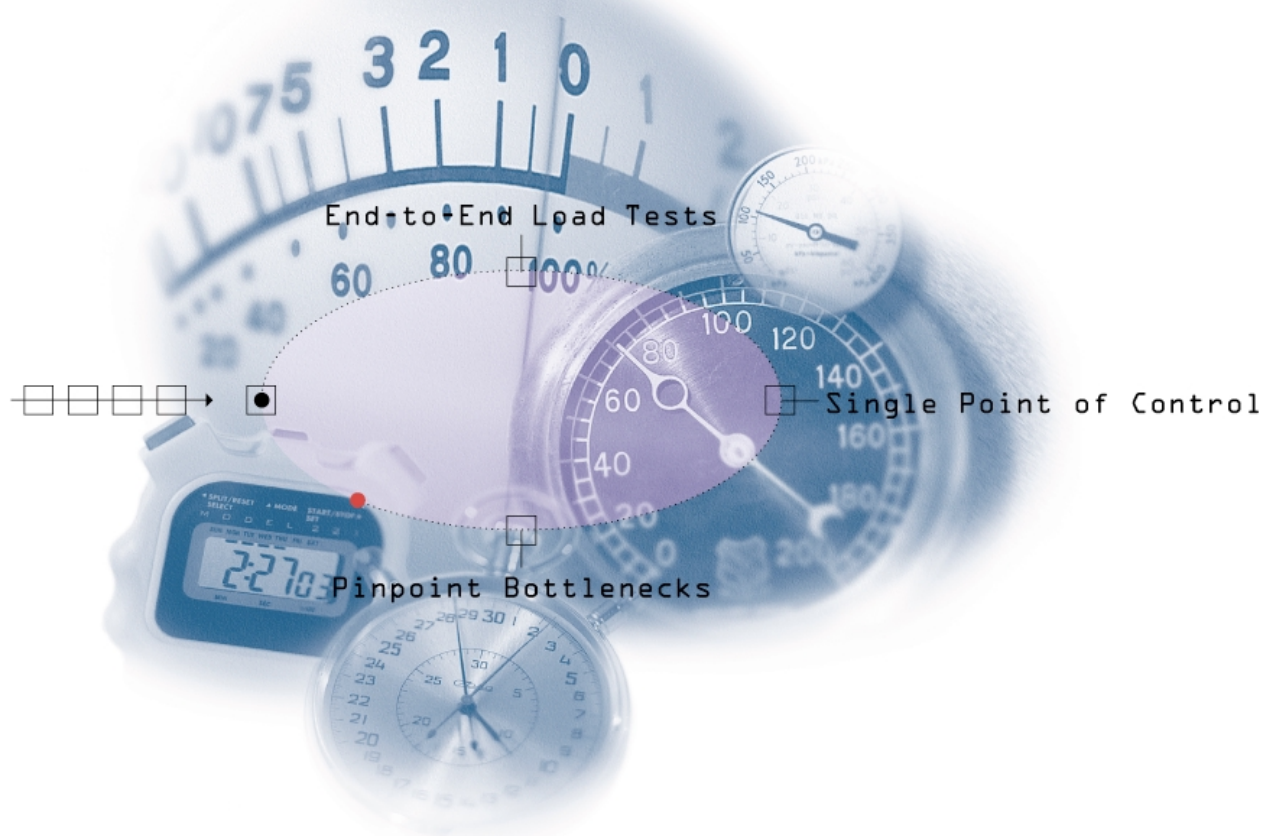
LoadRunner® is a load testing tool that predicts system behavior and performance. It exercises an entire enterprise infrastructure by emulating thousands of users to identify and isolate problems. LoadRunner's integrated real-time monitors enable organizations to minimize test cycles, optimize performance and accelerate deployment.

Corporate enterprises are evolving into sophisticated information systems that support thousands of users, multiple application environments and a complicated mix of different vendor components. As IT groups integrate e-business, enterprise resource planning (ERP), custom client/server and legacy applications into their enterprise systems, they need to be sure that these applications will perform as expected at deployment and remain reliable as the applications evolve.

The adoption of the new Internet business model has stressed the importance of application testing like never before. As an increasing number of companies are relying on e-business applications as the backbone of their operations and a significant source of revenues, testing application quality, reliability and scalability is becoming more than just a good idea—it's an absolute necessity.

Unpredictable user loads, enormous application complexity and a host of new and unproven Internet technologies mandate the need for automated load testing before, during and after application deployment. Failure to deliver 100% availability, flawless performance and a positive experience for all users at all times ultimately translates into lost customers, lost business and lost revenues.

Mercury Interactive's LoadRunner addresses the issues of testing complex, integrated enterprise infrastructures by providing a scalable and easy-to-use load testing solution. It stresses the entire enterprise system to identify and isolate problems, predict system behavior and optimize performance. LoadRunner emulates thousands of virtual users that drive the application as real users would, monitoring the behavior and response times of different application components. With its real-time monitors, LoadRunner allows users to view the

application's performance at any time, even before the load test is completed.

Through its open architecture, support for the widest range of application environments and seamless integration with other Mercury Interactive tools, LoadRunner provides a comprehensive, realistic and reliable load testing solution. Users can stress their system with different configurations, create realistic load scenarios based on real business processes, bombard their applications with requests from different IP addresses, browser types and dial-up connections, monitor and analyze test results in real time—all with minimal hardware and personnel resources.

With LoadRunner's intuitive user interface and comprehensive analysis monitors, users with no programming experience can test complex enterprise applications to determine if an application is ready for deployment.
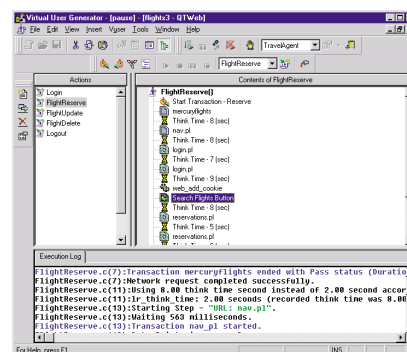
Generating Virtual Users

The main purpose of load testing is to observe system behavior under typical user loads. To create these loads you will need virtual users—agents that drive real client applications, imitating the business processes performed by real users. Virtual users significantly minimize hardware and personnel

The Virtual User Generator lets you capture application business processes to create virtual users.

resources required for load testing, as you can run hundreds or even thousands of them on just a few NT or UNIX machines, instead of using actual computers on every desktop.

To create virtual users, you must first use LoadRunner's Virtual User Generator—an engine that records business processes, such as an order entry, and translates them into test scripts. After scripts have been created, they can then be parameterized to mirror your enterprise workload. Parameterization is essential for testing applications with different sets of real-life data. In the example of the order-entry process, you may want to change hard-coded fields, such as a part number or customer name, into variables that allow you to test your application with multiple values. To create these values, you simply enter part numbers and customer names into an Excel-like spreadsheet or export them directly from a spreadsheet or database. This data-driven testing approach allows you to yield a realistic analysis of the actual business process. With LoadRunner, you can also control user behavior, such as the number of entries, transaction frequency and required think time. All of this can be done with a point and click, without any programming.

To get an accurate picture of how the system slowdown will affect user experience, load tests are usually run with at least one GUI virtual user on a client desktop with hundreds or thousands of "headless" virtual users on load-generating machines. A GUI virtual user actually drives the real client application from the GUI. Headless virtual users represent different types of clients, such as Web, ERP, database (DB), Java or remote terminal emulator (RTE) clients that run without the overhead of the client GUI. The Virtual User Generator can create virtual users for a variety of application

environments. GUI virtual user scripts are created by capturing GUI user interactions with WinRunner or XRunner. You can run any combination of virtual users against any mix of applications to best reflect your own enterprise application configuration.

As e-business applications are evolving into an integral part of corporate IT systems, there's a growing need to verify that these applications can handle the user load and deliver reasonable response times.

Many companies in the e-business space are bound by service level agreements (SLA)—a guarantee that a majority of all their transactions will occur within a specific time frame. To live up to these agreements and to provide a positive user experience, you need to know that all components of your e-business system are scaling up to the number of users. To do this, you need to create a Web virtual user—an agent that emulates the browser by sending and receiving messages to and from the Web server to generate system load. LoadRunner's Web virtual users can be configured to behave like any browser type or version, connection (LAN, WAN or dial-up connection speeds) or cache size.

Secure environments are the enabling technology for e-business, but they can greatly reduce performance and complicate application architectures. For customers deploying e-business applications with security requirements, LoadRunner provides complete support for SSL and digital certificates on both client and server side as well as NTLM authentication.

In addition, LoadRunner has the unique ability to assign different IP addresses to different virtual users for accurately predicting production user loads. This can help uncover potential performance problems and system bottlenecks that would not surface if all virtual users on the same
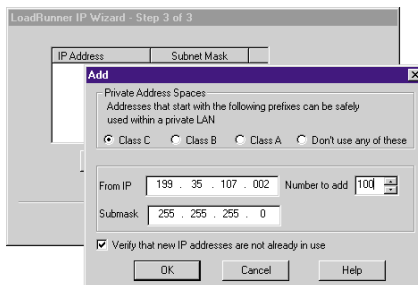
The IPSpoofer assigns IP addresses to different virtual users to help predict the impact on firewalls, routers and load balancers.

machine have the same IP address. LoadRunner's IPSpoofer allows virtual users on any given machine to use different IP addresses. This helps identify and isolate problems in system components previously left out of the testing process, such as predicting the real-world impact on firewalls, routers and load balancers.

Creating Load Scenarios

After virtual users have been created, you will need to define your load scenarios—the mix of business processes and the number of virtual users that will run on each load machine. With LoadRunner's Scenario Wizard you can quickly compose multi-user test scenarios. For instance, you can stress your application with thousands of desktop, terminal, Web and Java clients to see how Java users will affect your system when they access an ERP application over the Web. Similarly, you can set up a scenario where virtual users will access your e-business application with different dial-up connections. This will help you determine what response time a user will experience over a 56K modem versus an ISDN or a T1 line. LoadRunner seamlessly drives any mix of users to immediately identify and isolate any weaknesses in your application.

In addition, you can define load scenarios that show what happens to

the system when all users perform one action simultaneously—for example, log-in to an inventory application. You can also create scenarios that benchmark the performance of different vendor components—servers, databases, networking components, etc.—to help make informed purchasing decisions.

Driving and Controlling Load Tests

In load testing, it's critical that you have a central point of control for all aspects of your testing effort. LoadRunner features the visual Controller—an interactive environment for organizing, driving and managing the load test scenario. Its graphical interface helps you organize and control scenarios during load test setup and execution.

The Controller executes your load tests by driving hundreds or thousands of virtual users concurrently. Rendezvous points can be defined to synchronize and coordinate the load of virtual users, emulating the conditions of peak loads.

At any time during the test, you can view your application's performance by using the suite of integrated real-time monitors. Using LoadRunner's real-time performance monitors, you
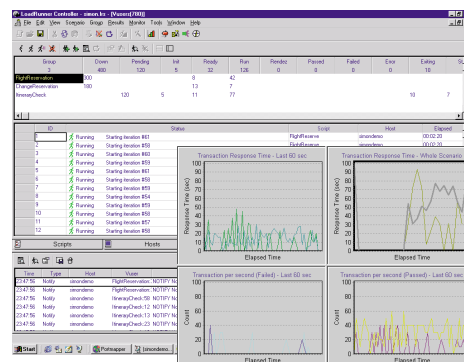
The Controller features integrated monitors to help identify and isolate performance bottlenecks in real-time.

can instantly access specific performance information on any part of the system, such as server, database or network, and view a real-time display of transaction performance data.

With the Transaction Monitor, you can identify performance problems by viewing real-time data on average transaction response times experienced by the end user. Once the problem has been identified, LoadRunner's other monitors can be used to further isolate the problem and pinpoint its source to a specific component of the system.

To look at an application's functionality from the end-user perspective and to ensure that Web page content is accurately delivered and displayed, testers can use ContentCheck at any time during the load test. ContentCheck gives testers a real-time picture of the client application under test through a browser interface to expose functional failures that occur only under heavy load.

Identifying and Isolating System Bottlenecks

While detecting performance bottlenecks during test execution is an extremely important task, just knowing that there is a problem is not enough. The next task is to actually determine where the problem lies and drill down to identify a specific part of the architecture that's slowing down the overall application response time. LoadRunner's integrated real-time monitors allow users to isolate performance bottlenecks by splitting the end-to-end transaction response time into separate components of the client, network and server. For example, the Server Monitor can locate the problems associated with the system servers, such as Web servers, application servers or database servers, as they become loaded. Similarly, the Network Delay Monitor isolates network performance problems by breaking down the network topology between the client and the server and
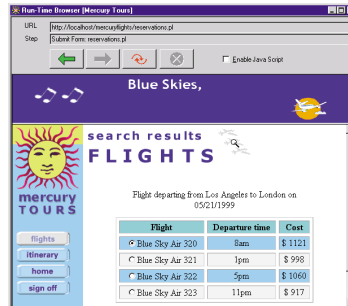
ContentCheck gives testers a real-time picture of the client application under test through a browser interface. It exposes functional failures that occur only under heavy load.

measuring the network delay between these segments. SNMP and TUXEDO Monitors are used to find performance problems in respectively SNMP-compliant system components and TUXEDO-based applications. Finally, the Transaction Breakdown Monitor can isolate problems within the database.

For example, you may have determined that the response time of your system under a load of 5,000 users is 20 seconds. The Transaction Breakdown Monitor will break it down to 5 seconds on the client and network and 15 seconds on the server. Furthermore, it will determine that of the15 seconds on the server, 10 seconds were spent on locking, 2 seconds on the CPU and 3 seconds on I/O. In other words, 10 out of 20 seconds of the overall response time were spent on the database server, specifically on database locking. With accurate information about the location and nature of the bottleneck, you can immediately bring in the right personnel to correct the problem and accurately reproduce it for further testing.

At the end of the testing process, you can use LoadRunner to create a series of graphs and reports that summarize your test results and present them in a clear and visual format. For added versatility, these graphs

and reports can be easily exported to Microsoft Word, Microsoft Excel, Lotus 1-2-3, e-mail and more. Using LoadRunner's expanded testing capabilities, you can now not only exercise an entire enterprise infrastructure, but you can also isolate problems in order to optimize performance and accelerate deployment.

LoadRunner Real-Time Performance Monitors

- **Transaction Monitor** gathers information on average user transaction response time and transaction throughput in real-time

- **Server Monitor** identifies performance problems associated with the system servers, such as Web servers, application servers and database servers

- **Network Delay Monitor** provides a breakdown of network performance by segment

- **SNMP Monitor** finds performance problems of any SNMP-compliant system component—typically network hardware, such as bridges and routers

- **TUXEDO Monitor** locates performance problems within the TUXEDO application server

- **Transaction Breakdown Monitor** finds performance problems in the database

The need for comprehensive load and performance testing in the enterprise is mission-critical. IT depends on automated load testing to ensure the quality, performance and security of their enterprise business systems.

E-business applications: As e-business applications are becoming an integral part of IT systems, companies are often faced with a high risk due to the combination of multi-tier architectures, secure environments, multiple protocols and components, unpredictable user loads and the uncertainty of Internet bandwidth. Poor application performance can result in lost opportunities, revenue losses or even business failure. LoadRunner helps ensure flawless performance of these mission-critical systems upon deployment and throughout the lifecycle.
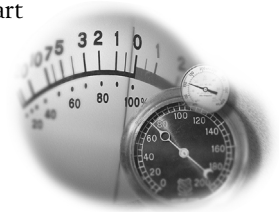
Enterprise Resource Planning (ERP) applications: ERP applications are complex client/server applications that give corporations the enabling technology to replace separate, disconnected information systems with an integrated system for planning, monitoring and controlling their businesses. Although the application itself is packaged, customization of business processes and components introduces risk into the implementation process. Insufficient network bandwidth, architectural inoperability, databases that do not scale properly as the number of users increases and new hardware or system upgrades may seriously affect the application's performance. LoadRunner stresses the system with production-levels of real business processes to reflect accurate usage patterns and detect breaking points before new configurations are made.

Custom Client/Server: IT departments continue to implement custom client/server systems. With LoadRunner, system architects can make informed decisions about their system—from architecture design, to integration and performance testing, through fine-tuning to product tests. The complexity of client/server systems requires additional monitoring capabilities to provide more information about the system under load. Host monitors, network delay information and response time breakdowns help pinpoint and isolate system performance bottlenecks.

Legacy Applications: IT departments continue to upgrade, develop and deploy legacy applications because of their time-proven reputation for scalability and performance. Year 2000 and Euro conversion processes often introduce performance problems to previously effective legacy systems. In addition to testing application functionality after conversion, LoadRunner helps year 2000 project teams test for performance problems associated with date corrections such as extra processing time, heavy data storage or increased memory requirements.

Complete Enterprise Application Support

LoadRunner supports the widest range of enterprise application environments, including:

E-Business:	JDBC, LDAP, CORBA, POP3, FTP, HTTP, SSL, Digital Certificates, NTLM
ERP:	SAP, Oracle Applications, PeopleSoft, Baan
n-tier:	Jolt, TUXEDO, DCOM
2-tier:	Oracle, Sybase, MS SQL Server, Informix, ODBC, Winsock
Legacy:	3270, 5250, VT100-520, APPC (AS/400), X-Window

Supported Platforms

Controller/Virtual User Generator/Analysis supports the following platforms:
- Windows NT
- Windows 95
- Windows 98

Virtual User replay supports the following platforms:
- Windows NT
- Sun Solaris
- HP-UX
- IBM AIX
- LINUX

Open Test Architecture

Open Test Architecture™ is the foundation of Mercury Interactive's enterprise testing solutions. It integrates Mercury Interactive's LoadRunner, TestDirector and WinRunner with a variety of third-party applications, enabling IT organizations to create customized test solutions that are tailored to the needs of their testing process. With OTA, companies can maximize their investment in existing infrastructure tools, while still responding quickly to changing business requirements.

To provide customers with open and extendable testing environment, LoadRunner features an open API, enabling users or third-party vendors to integrate LoadRunner into their unique environments. For example, LoadRunner can be configured to integrate with proprietary protocols that are not natively part of its supported environments. Similarly, LoadRunner can be integrated with third-party monitoring tools for enhanced performance monitoring and bottleneck isolation capabilities.

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